The Genus *Chitrella* in America (Pseudoscorpionida, Syarinidae)

William B. Muchmore
Department of Biology, University of Rochester, Rochester, New York 14627

Received for Publication July 2, 1973

Abstract: Since the paper of Malcolm and Chamberlin (1960) on "The pseudoscorpion genus *Chitrella*," a number of new specimens have come to hand, giving further support to the idea that this genus is widely represented in the eastern United States. In 1963 the present author redescribed the tritonymph holotype of *Obisium cavicola* Packard and assigned the species to *Chitrella*.

This paper describes, for the first time, adults of *Chitrella cavicola* (Packard) and extends our knowledge of the range of that species, describes a male of *C. regina* Malcolm and Chamberlin, describes a new cavernicolous species, *C. superba*, from Virginia, and discusses the relationships of *C. transversa* (Banks) from New Mexico.

Suborder Diplosphyronida Chamberlin
Family Syarinidae Chamberlin
Subfamily Chitrellinae Beier
Genus *Chitrella* Beier

Chitra Chamberlin, 1930, p. 41.
Chitrella Beier, 1932, p. 165; Hoff, 1956, p. 20; Malcolm and Chamberlin, 1960, p. 2.

Type species: *Chitra cala* Chamberlin, 1930, p. 41.

Diagnosis (emended): Diplosphyronid pseudoscorpions with pleural membranes of abdomen longitudinally, smoothly striate; both fingers of chelicera with marginal teeth; spinneret apparently absent from movable cheliceral finger; venedens and venom duct well developed in fixed finger of chela, venom duct short; terminal tooth of movable chelal finger short and without trace of venom duct; marginal teeth of chelal fingers numerous, contiguous; trichobothria of fixed finger arranged in two more or less distinct groups, *et*, *it*, *est* and *ist* distally with *ist* at about middle of finger, and *esb*, *isb*, *eb* and *ib* proximally with *ib* clearly on dorsum of hand; *st* of movable finger nearer to *t* than to *sb*; leg I with telofemur longer than basifemur; articulation between basifemur and telofemur of leg IV slightly oblique to transverse axis; posterior genital operculum of male with one pair of small setae internally; in most species, sixth sternite of male with a median, circular area containing a number of microsetae (presumably sensory); median cribriform plate of female circular and heavily sclerotized.

Acknowledgments: Special thanks are due to Dr. Thomas C. Barr, Jr., Dr. Carl Krekeler and Mrs. Charlotte H. Alteri for making certain specimens available for study. This work was aided by research grants (GB 17964 and GB 37570) from the National Science Foundation.

Chitrella cavicola (Packard)

(Figs. 1–4)

Obisium cavicola Packard, 1884, p. 202.
Microcreagris? cavicola, Beier, 1932, p. 157; Hoff, 1958, p. 12.
Chitrella cavicola, Muchmore, 1963, p. 11.

Heretofore this species has been known only from the holotype tritonymph from New Market Cave, Shenandoah County, Virginia. It now appears that the species may actually be widespread in the middle Atlantic states and that it is mainly an epigean, rather than a cavernicolous, form. On the basis of new material studied, the adults can be described for the first time and a more complete description of the tritonymph can be presented.

Material: Many males, females and nymphs from Fredericksburg National Military Park, Spotsylvania County, Virginia, 10 April 1969 (C. H. Alteri); one female from Lewis Mountain (2,000 feet elevation), Shenandoah National Park, Virginia, 10 April 1967 (S. Peck); several tritonymphs and one deutonymph from Big Meadows and Thorofare Mountain Overlook (about 3,500 feet elevation), Shenandoah National Park, 2 July 1963 (W. B. Muchmore); one female from Whiting's Neck Cave, Berkeley County, West Virginia, 26 March 1966 (J. Cooper).

Diagnosis (emended): Generally similar to *Chitrella cala* Chamberlin, and *C. muesebecki* Malcolm and Chamberlin, but smaller than the former and larger than the latter and with specific differences as indicated in the key.

Description of adults (based upon six mounted males and eight mounted females): Males and females indistinguishable in size and proportions. All sclerotized parts pale reddish brown. Carapace about one-third longer than broad; no epistome; no transverse furrows; two well-developed eyes on each side, anterior eyes slightly more than one ocular diameter from anterior margin and about half a diameter from posterior eyes; with about 30 vestitural setae, including, usually, six along anterior and six near posterior margin and a small seta anteroventral to each anterior eye. Abdominal tergal chaetotaxy about 6 or 7:11:11:12:13:14:15:13:13:11:5:2. Sternal chaetotaxy of males about 14:[1–1]: $(4)\frac{6}{14}(4):(4)20(4):25:\frac{4(N)4}{18}$:17:18:16:14:9:2; middle 8–10 setae on sternites 4 and 5 distinctly smaller than those more laterad; the circular area (N, according to terminology of Malcolm and Chamberlin, 1960, p. 14) on sternite 6 with variable number of clusters of microsetae; two larger setae near middle of sternite 7 are in the marginal row, not displaced anteriorly as in *C. cala* (see Fig. 1). Sternal chaetotaxy of females about 8: $(4)17(4):(4)12(4):15:\frac{2}{15}$:18:15:14:13:9:2; two small setae near middle of sternite 6 lie anterior to the marginal row.

Chelicera about 0.6 as long as carapace. Hand with five setae; fixed finger with 15–20 and movable finger with 10–15 teeth of varied sizes; no galea or silk ducts visible; serrula exterior of about 25 blades; flagellum usually of six setae, all except proximal one serrate along one margin.

Palps moderately long and slender; femur about 1.0 and chela about 1.6 times as long

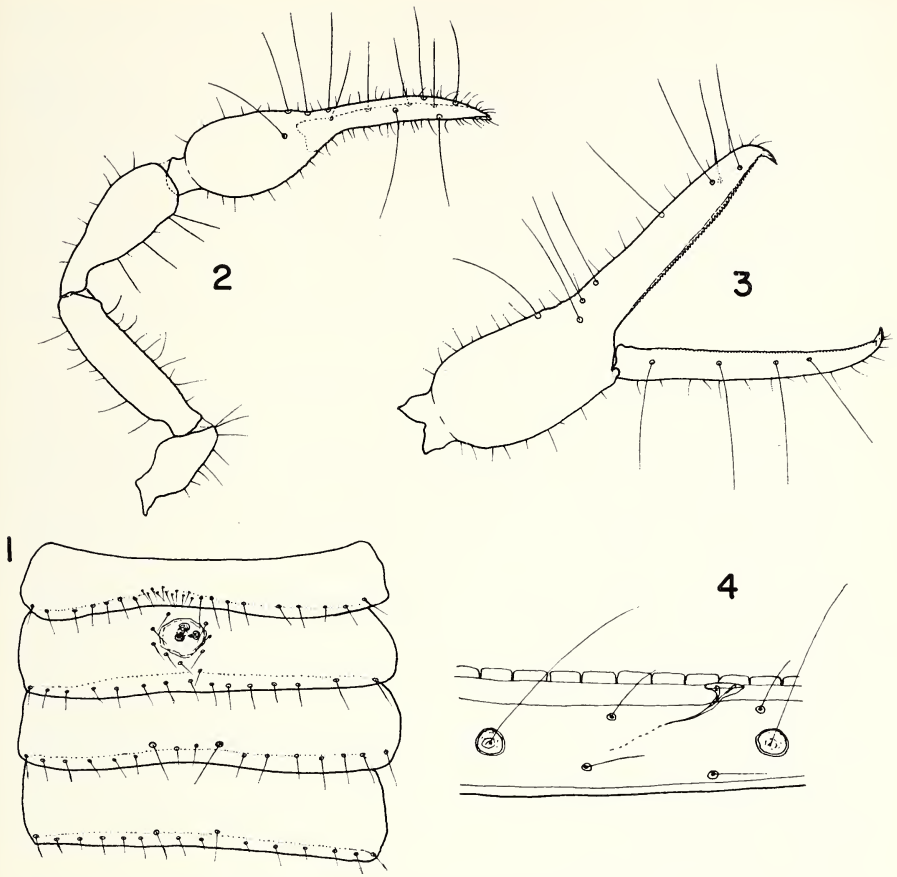


Fig. 1–4. *Chitrella cavicola* (Packard). 1. Sternites 5–8 of male. 2. Dorsal view of left palp. 3. Lateral view of right chela. 4. Part of movable finger of chela showing sensillum near dental margin (trichobothrium *st* at right, *sb* at left).

as carapace. Proportions of palpal segments as shown in Fig. 2; trochanter 2.3–2.6, femur 3.7–4.15, tibia 2.45–2.7, and chela (without pedicel) 3.5–3.7 times as long as broad; hand (without pedicel) 1.5–1.65 times as long as deep; movable finger 1.5–1.6 times as long as hand. All segments sparsely granulate, and with distinct concentrations of granules on flexor surface of femur and on chelal hand at bases of fingers. Fixed chelal finger with row of 50–59 contiguous, retroconical teeth; movable finger with 54–62 low, rounded teeth, only the distalmost four or five with cusps. Venedens and venom apparatus in fixed finger only, venom duct very short; terminal tooth of movable finger short and with no evidence of a venom duct. Positions of trichobothria as shown in Fig. 3. Movable finger with a small, rounded sensillum just external to the dental row and posterior to the level of trichobothrium *st* (Fig. 4).

Legs moderately long and slender; leg IV with entire femur 2.95–3.2 and tibia 4.8–5.3 times as long as deep. Leg IV with tactile setae on tibia about two-thirds and on meta-

tarsus about one-fourth length of segment from proximal end. Subterminal tarsal setae with 3–5 sharp rami in distal half.

Tritonymph (based on nine mounted specimens from Spotsylvania County, nine from Shenandoah National Park, and the holotype from New Market Cave): The description by Muchmore (1963, pp. 12, 13) is generally satisfactory; only a few points need clarification and some indications of variability can be given. The number of vestitural setae on the carapace varies from 27 to 31, usually with six at both anterior and posterior margins; included in this number are two setae, smaller than the rest, one just anteroventral to each anterior eye (as in the adult). Tergal chaetotaxy of a typical specimen 7:11:11:11:11:12:12:11:11:8:3:2. Sternal chaetotaxy of typical specimen 2:(3)8(3):(3)9(3):11:$\frac{2}{12}$:13:12:10:11:7:2; two small setae on sternite 6 lying close together at about the center of the sternite.

Chelicera much as described previously. However, flagellum difficult to make out accurately; apparently consisting of five setae, all but the shorter, basal one finely denticulate along one margin.

Palps much as described earlier. Proportions of segments: trochanter 2.0–2.45, femur 3.55–3.8, tibia 2.1–2.55, and chela (without pedicel) 3.3–3.7 times as long as broad; hand (without pedicel) 1.4–1.55 times as long as deep; movable finger 1.37–1.53 times as long as hand. Fixed chelal finger with 35–42 and movable finger with 40–46 contiguous teeth. Movable finger with a rounded sensillum like that found in adult, located usually at level of trichobothrium *st*.

All legs with telotarsi swollen basally, as noted earlier. Leg IV with tactile setae on tibia 0.53–0.70 and on metatarsus 0.25–0.32 length of segment from proximal end. Subterminal tarsal setae variably dentate, as in adult.

Measurements (in mm): Males and females: Body length 2.0–2.7. Carapace 0.57–0.69, ocular breadth 0.44–0.49. Chelicera 0.34–0.40 by 0.155–0.18. Palpal trochanter 0.35–0.40 by 0.14–0.17; femur 0.57–0.66 by 0.14–0.17; tibia 0.50–0.57 by 0.19–0.23; chela (without pedicel) 0.95–1.12 by 0.26–0.31; hand (without pedicel) 0.38–0.445 by 0.24–0.29; movable finger 0.59–0.68 long. Leg IV: entire femur 0.51–0.59 long; basifemur 0.19–0.22 by 0.155–0.185; telofemur 0.33–0.385 by 0.17–0.19; tibia 0.41–0.48 by 0.08–0.10; metatarsus 0.19–0.22 by 0.06–0.08; telotarsus 0.24–0.28 by 0.05–0.06.

Tritonymphs: Body length 1.54–2.29. Carapace 0.45–0.555 long. Chelicera 0.265–0.315 by 0.125–0.15. Palpal trochanter 0.23–0.30 by 0.105–0.13; femur 0.39–0.48 by 0.11–0.145; tibia 0.335–0.41 by 0.14–0.18; chela (without pedicel) 0.65–0.78 by 0.185–0.23; hand (without pedicel) 0.27–0.33 by 0.18–0.22; movable finger 0.395–0.49 long. Leg IV: entire femur 0.335–0.42 by 0.115–0.155; tibia 0.28–0.34 by 0.065–0.08; metatarsus 0.13–0.155 by 0.05–0.06; telotarsus 0.175–0.21 by 0.05–0.06.

Remarks: Although the first known specimen of *C. cavicola* was found in a cave, it now appears that the species is normally surface dwelling. The specimens from Fredericksburg, Virginia, were living in very damp litter in deciduous woodland, while those from Shenandoah National Park were found in damp leaf litter at the bases of large boulders, also in deciduous woodland. Such a moisture-loving hypogean form is probably admirably suited for entering and surviving in caves—witness the holotype and the specimen from Whiting's Neck Cave.

The sensillum on the external surface of the movable chelal finger is the same structure as that called an "accessory tooth" by Malcolm and Cham-

berlin in *C. muesebecki* (1960, p. 10). (The identity of these structures was confirmed by direct examination of the holotype of *C. muesebecki.*) It usually appears as a rounded elevation with a shallow depression at the summit in which are seen one or two sensory pegs. Similar sensilla are found on the movable finger of *C. archeri*, where there are usually two, one at a level between trichobothria *st* and *sb*, and the other between *sb* and *b*. Further, such a sensillum is present just distad of *sb* in the one specimen of *C. cala* which I have been able to examine. As noted below, these sensilla are also found in all other American species of *Chitrella*. Whether they will prove to be of taxonomic significance remains to be determined.

Chitrella regina Malcolm and Chamberlin
(Fig. 5)

Chitrella regina Malcolm and Chamberlin, 1960, p. 7.

The original diagnosis of this species is based on a single female specimen from Coffman Cave, near Frankford (*not* Frankfurt), Greenbrier County, West Virginia. The present description of a male from a neighboring cave is given as a supplement to that diagnosis.

Material: One male (WM 261.01001) collected in Higginbotham's Cave, 1½ miles WNW of Frankford, Greenbrier County, West Virginia, by Carl Krekeler on 24 July 1957.

Description of male: Quite similar to the female described by Malcolm and Chamberlin, but slightly smaller and with the following characteristics. Carapace about one-third longer than broad; with four barely discernible eyespots; chaetotaxy 6-6-4-2-4 = 22, the lateralmost setae in the second row being much reduced in size. Abdominal tergal chaetotaxy 4:6:6:8:9:8:10:10:10:7:5:2. Sternal chaetotaxy $15:[1\text{-}1]:\frac{13}{(4)13(4)}:(4)16(4):18:\frac{4(N)5}{13}:5T2T5:14:12:9:7:2$; middle six or seven setae on sternites 4 and 5 distinctly smaller than those more laterad; the circular area (N) on sternite 6 bears a single cluster of 25–30 closely set microsetae; the two tactile setae on sternite 7 are in line with the other marginal setae (Fig. 5).

Chelicera nearly two-thirds as long as carapace. Hand with five setae; fixed finger with 13 and movable finger with ten teeth; no galea or silk ducts visible; serrula exterior of 25 blades; flagellum of seven setae, all finely serrate on anterior edges.

Palp as in female; femur 1.55 and chela 2.35 times as long as carapace. Proportions of palpal segments: trochanter 2.85, femur 7.05, tibia 5.4, and chela (without pedicel) 6.15 times as long as broad; hand (without pedicel) 2.1 times as long as deep; movable finger 2.05 times as long as hand. Movable chelal finger with 114 and fixed finger with 109 marginal teeth. Movable finger with two small rounded sensilla lying between trichobothrium *sb* and the dental row. Trichobothria as in female, except that *t* is closer to *st* than is indicated in the figure by Malcolm and Chamberlin (1960, Fig. 2B, p. 8).

Legs generally similar to those of female. Leg IV with tactile setae on tibia 0.63 and on metatarsus 0.28 length of segment from proximal end. Subterminal tarsal setae with one or two small rami at midpoint and terminally.

Measurements (in mm): Body length 2.34. Carapace 0.79. Chelicera 0.49 by 0.21. Palpal trochanter 0.585 by 0.205; femur 1.23 by 0.175; tibia 1.11 by 0.205; chela (without pedicel) 1.84 by 0.30; hand (without pedicel) 0.63 by 0.30; pedicel 0.11 long; movable

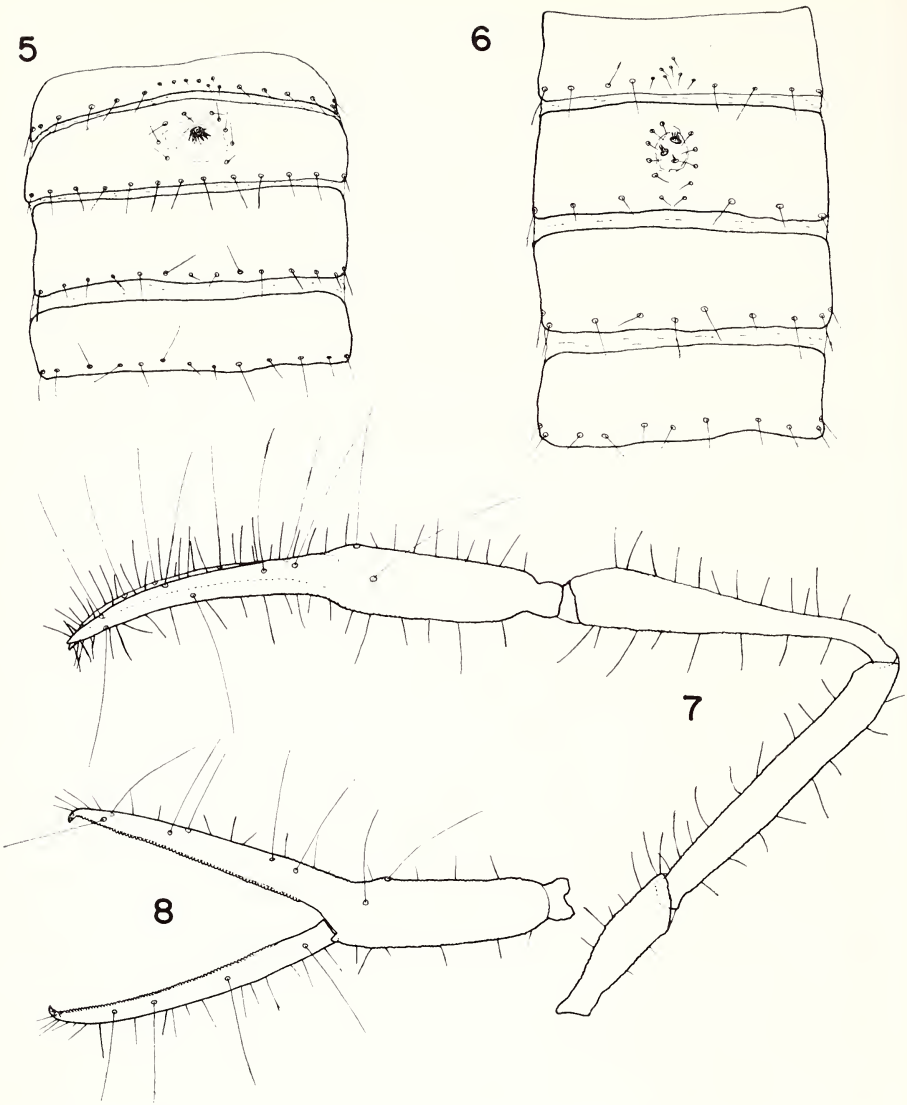


FIG. 5. *Chitrella regina* Malcolm and Chamberlin. Sternites 5–8 of male.

FIGS. 6–8. *Chitrella superba*, new species. 6. Sternites 5–8 of male. 7. Dorsal view of right palp. 8. Lateral view of left chela.

finger 1.28 long. Leg I: basifemur 0.555 by 0.115; telofemur 0.34 by 0.10; tibia 0.505 by 0.08; metatarsus 0.225 by 0.065; telotarsus 0.365 by 0.06. Leg IV: entire femur 0.913 long; basifemur 0.34 by 0.16; telofemur 0.585 by 0.16; tibia 0.78 by 0.10; metatarsus 0.315 by 0.09; telotarsus 0.465 by 0.08.

Remarks: Higginbotham's Cave, in which the present male was found,

is situated very close to Coffman Cave, the type locality of the species. It is probable that there are underground connections between the two caves through which pseudoscorpions could disperse (see Davies, 1958, p. 82).

It is interesting to find that the male of *C. regina* possesses the unique sensory area on the sixth sternite characteristic of most species of *Chitrella*.

Chitrella superba, new species
(Figs. 6–8)

Material: Holotype male (WM 279.01002) and paratype male collected in Madden's Cave, Shenandoah County, Virginia, 25 August 1958, by Thomas C. Barr, Jr. The types are deposited in the collection of the American Museum of Natural History in New York.

Diagnosis: A large, blind species with greatly attenuated appendages, generally similar to members of the European genus *Pseudoblothrus* Beier.

Description of male: Carapace about 1.6 times as long as broad, greatest breadth in "ocular" region; anterior margin smoothly rounded; surface finely reticulated; eyes completely lacking. Carapacial chaetotaxy 6-6-4-4-4 = 24, lateralmost setae in second row much reduced in size. Coxal area typical; chaetotaxy 2-12(10):6:8:4:8. Abdomen elongate; surfaces of tergites and sternites finely reticulated; pleural membranes longitudinally striate. Tergal chaetotaxy 4:6:8:8:9:9:9:9:6:5:2 (paratype with seven setae on second tergite and nine on third). Sternal chaetotaxy $13:[1\text{-}1]:\frac{7}{(4)15(4)}:(4)18(4):16:\frac{5(N)4}{9}:11:11:11:10:7:2$: Sternite 4 with 3–6 and sternite 5 with a group of 7–12 smaller setae at center of marginal row (see Fig. 6); sternite 6 of holotype with a medial, nearly circular, and slightly depressed area (N), surrounded by nine irregularly placed, large setae; just anterior to center of the area is a compact group of about 25 microsetae, behind this a pair of microsetae, and behind the pair a single, isolated microseta (paratype similar, but not identical); sternite 7 with no distinctly larger setae near middle of row.

Chelicera little more than half as long as carapace. Hand with five setae; fixed finger with 22–24 teeth, more or less alternating large and small; movable finger with 12–13 similar teeth; no evidence of galea or silk duct; serrula exterior with 30–32 blades and serrula interior with 18–20 blades; flagellum of seven setae, all finely serrate along anterior margin.

Palp very long and slender; femur about 1.61 and chela about 2.17 times as long as carapace. Proportions of palpal segments as shown in Fig. 7; trochanter 3.45–3.5, femur 7.85, tibia 5.65, and chela (without pedicel) 6.9 times as long as broad; hand (without pedicel) 3.0 times as long as deep; movable finger 1.39–1.42 times as long as hand. All surfaces heavily granulate, except chelal fingers. Fixed finger with row of about 90 teeth, those in distal third bluntly pointed, the rest low and rounded; movable finger with about 105 teeth, the distalmost 8–10 bluntly pointed, the rest low and rounded. Only fixed finger with venedens, venom duct very short. Movable finger with a single, small sensillum situated obliquely between trichobothrium *sb* and dental margin. Positions of trichobothria as shown in Fig. 8.

Legs long and slender; leg IV with femur 4.9 and tibia 7.5–7.7 times as long as deep. Fourth leg with tactile setae on tibia 0.54–0.56, on metatarsus 0.47–0.49, and on telotarsus 0.55 length of segment from proximal end. Subterminal tarsal setae with one or two prominent rami distally.

Female: Unknown.

Measurements (in mm) (first figures are for holotype, with those for paratype in parentheses): Body length 4.15 (3.97). Carapace 1.16 (1.15) long, "ocular" breadth 0.75 (0.69). Abdomen 2.99 (2.82) long by 1.09 (0.99) broad. Chelicera 0.64 (0.61) long by 0.29 (0.28) broad; movable finger 0.42 (0.40) long. Palpal trochanter 0.92 (0.93) by 0.26 (0.27); femur 1.89 (1.83) by 0.24 (0.23); tibia 1.82 (1.77) by 0.32 (0.31); chela 2.51 (2.51) by 0.37 (0.37); hand 1.09 (1.09) by 0.37 (0.37); pedicel 0.12 (0.12) by 0.25 (0.24); movable finger 1.55 (1.52) long. Leg I: basifemur 0.86 (0.85) by 0.16 (0.15); telofemur 0.48 (0.46) by 0.13 (0.12); tibia 0.72 (0.73) by 0.11 (0.10); metatarsus 0.38 (0.37) by 0.09 (0.09); telotarsus 0.48 (0.49) by 0.08. Leg IV: entire femur 1.28 (1.26) long; basifemur 0.41 (0.41) by 0.26 (0.26); telofemur 0.90 (0.88) by 0.26 (0.26); tibia 1.04 (1.01) by 0.14 (0.13); metatarsus 0.48 (0.45) by 0.10 (0.10); telotarsus 0.60 (0.58) by 0.08 (0.09).

Etymology: This species is named *superba* because of its magnificent size.

Remarks: If this species had been found in Europe it would certainly have been placed in the genus *Pseudoblothrus* Beier. However, its presence in eastern United States together with its obvious close similarity to other American species of *Chitrella* mandates its inclusion in the latter genus. Vachon (1969) has already pointed out the difficulty of distinguishing between the genera *Chitrella* and *Pseudoblothrus* on the basis of characters commonly used. The possibility that the genera are synonymous must be seriously considered, but a final decision in the matter can be reached only after detailed comparative study of American and European forms.

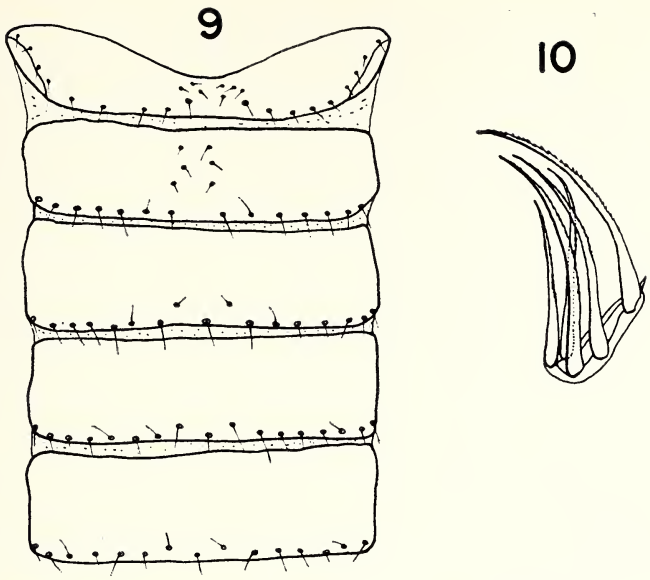
Chitrella transversa (Banks)
(Figs. 9 and 10)

Obisium transversum Banks, 1909, p. 307.
Chitrella transversa, Hoff, 1956, p. 21; 1961, p. 434.

Hoff (1956, 1961) has redescribed and discussed this species in considerable detail, using material from New Mexico and Colorado, though he did not examine the type specimen of *Obisium transversum* in the Museum of Comparative Zoology (see 1956, p. 21). The holotype, a female, has subsequently been mounted on a microscope slide and examined carefully by the present author. In all respects it falls within the ranges of measurements of Hoff's specimens; there is no doubt that all of these are conspecific.

While Hoff has described most features of *C. transversa* adequately, there are several aspects of its morphology that need clarification in the light of recent study of other species in the genus.

Reexamination of the abdominal sternites of a number of specimens from both New Mexico and Colorado have confirmed the observation of Hoff that there is nothing on the sixth sternite of males comparable to the circular sensory or glandular area found in *C. cala* and other species. On the other hand, the sternal chaetotaxy of *C. transversa* males has some peculiarities of its own, as shown in Fig. 9: on sternite 4 there is a group of smaller setae near the middle as in other species; sternite 5 is unique, however, in having several (4 to 7) smaller setae near the middle, situated well anterior to the marginal row; sternite 6 usually has one or two small setae near the middle, slightly anterior to the marginal row; on sternite 7 two larger setae near the middle are essentially part of



Figs. 9 and 10. *Chitrella transversa* (Banks). 9. Sternites 4–8 of male. 10. Flagellum of chelicera.

the marginal row. Such an arrangement of sternal setae is quite similar to that described for *Pseudoblothrus thiebaudi* Vachon (1969, p. 388). This observation makes even more intriguing the question of the relationship between species presently assigned to *Chitrella* and *Pseudoblothrus*. However, as noted above, a resolution of the problem must await further study and comparison of both American and European material.

Like other species of *Chitrella, C. transversa* has a small sensillum on the exterior surface of the movable chelal finger. In this case, the organ is usually located posterior to trichobothrium *sb* and at some distance from the dental margin.

The cheliceral flagellum consists of five setae, subequal in length and all finely serrate along the distal margin; the distalmost of these is heavier than the others and distinctly separated from them at the insertion (Fig. 10). The form and arrangement of these flagellar setae appear to be unique in the genus, but confirmation of this opinion must await further critical study of favorable material.

Key to species of *Chitrella*

1. Sixth sternite of male with circular central area containing patches of microsetae (it is assumed that *C. muesebecki* belongs here, even though the male is as yet unknown 2

   Sixth sternite of male without a specialized area containing microsetae; known from New Mexico and Colorado ..... *C. transversa* (Banks)

2. Modified for cave dwelling: eyes absent; relatively large size, with length of palpal femur 0.75 mm or greater; attenuation of appendages, with length/breadth ratio of palpal femur 4.4 or greater 3

   Not so modified: with four corneate eyes; length of palpal femur usually less than 0.70 mm; length/breadth ratio of palpal femur less than 4.2 5

3. Appendages moderately attenuated, with length/breadth ratio of palpal femur about 4.5 and of chela about 4.0; known from caves in Grundy and Smith Counties, Tennessee ..... *C. archeri* Malcolm and Chamberlin
   Appendages greatly attenuated, with length/breadth ratio of palpal femur and chela both greater than 6.0 4
4. Length of palpal femur greater than 1.8 mm, with length/breadth ratio greater than 7.5; known from a cave in Shenandoah County, Virginia ..... *C. superba*, new species
   Length of palpal femur about 1.2 mm, with length/breadth ratio 7.1 or less; known from caves in Greenbrier County, West Virginia ..... *C. regina* Malcolm and Chamberlin
5. Carapace heavily sclerotized and with distinct transverse furrow; movable chelal finger usually less than 1.4 times as long as hand; seventh sternite of both sexes with a median pair of prominent setae in large areoles set anterior to the marginal row; known from California and Utah ..... *C. cala* Chamberlin
   Carapace lightly sclerotized, with little or no evidence of transverse furrow; movable chelal finger 1.5 or more times as long as hand; seventh sternite without a prominent pair of setae set anterior to the marginal row 6
6. Smaller species, with palpal femur about 0.5 mm and chela about 0.85 mm in length; sensillum on movable chelal finger distal to level of trichobothrium *t*; known from Roane County, Tennessee ..... *C. muesebecki* Malcolm and Chamberlin
   Larger species, with palpal femur greater than 0.55 mm and chela greater than 0.95 mm in length; sensillum on movable chelal finger proximal to level of trichobothrium *st*; known from several localities in Virginia and from Berkeley County, West Virginia ..... *C. cavicola* (Packard)

Literature Cited

BANKS, N. 1909. New Pseudoscorpionida. Canad. Ent., **41:** 303–307.

BEIER, M. 1932. Pseudoscorpionidea. I. Subord. Chthoniinea et Neobisiinea. Tierreich., **57:** 1–258.

CHAMBERLIN, J. C. 1930. A synoptic classification of the false scorpions or chela-spinners, with a report on a cosmopolitan collection of the same. Part II. The Diplosphyronida (Arachnida, Chelonethida). Ann. Mag. Nat. Hist., ser. 10, **5:** 1–48, 585–620.

DAVIES, W. E. 1958. Caverns of West Virginia. West Virginia Geol. Surv., Vol. XIX (A). Pp. 1–330.

HOFF, C. C. 1956. Diplosphyronid pseudoscorpions from New Mexico. Amer. Mus. Novitates, **1780:** 1–49.

———. 1958. List of the pseudoscorpions of North America north of Mexico. Amer. Mus. Novitates, **1875:** 1–50.

———. 1961. Pseudoscorpions from Colorado. Bull. Amer. Mus. Nat. Hist., **122:** 409–464.

MALCOLM, D. R. AND CHAMBERLIN, J. C. 1960. The pseudoscorpion genus *Chitrella* (Chelonethida, Syarinidae). Amer. Mus. Novitates, **1989:** 1–19.

MUCHMORE, W. B. 1963. Redescriptions of some cavernicolous pseudoscorpions (Arachnida, Chelonethida) in the collection of the Museum of Comparative Zoology. Breviora, **188:** 1–15.

PACKARD, A. S. 1884. New cave arachnids. Amer. Nat., **18:** 202–204.

VACHON, M. 1969. Remarques sur la famille des Syarinidae J. C. Chamberlin (Arachnides, Pseudoscorpions) à propos de la description d'une nouvelle espèce: *Pseudoblothrus thiebaudi* habitant les caverns de Suisse. Rev. Suisse Zool., **76:** 387–396.